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EP 1020673 A1 US 5271977 A
US 4570680 A US 20020056481 A1

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(54) Abstract Title
Fluid conduit

(57) The present invention relates to a fluid conduit (10), and to a multi-conduit umbilical (26) for use in the transportation of chemicals with small molecular size and shape e.g. methanol ethanol and other hydrocarbon fluids used in the oil industry. The conduit (10) comprises a flexible fluid hose (12) encapsulated by at least one metallised layer (14) which is formed and arranged to minimise permeation of a fluid being transported in the fluid hose (12). In use in a multi-conduit umbilical (26) the metallised layer (14) minimises permeation into adjacent fluid hoses containing chemicals. The invention is characterised in that the fluid hose(s) have differing levels of encapsulation and thereby permeation, along a given length according to the operational requirements of the fluid conduit/umbilical. Typically such fluid conduits/umbilicals will have lengths in excess of 100 km.

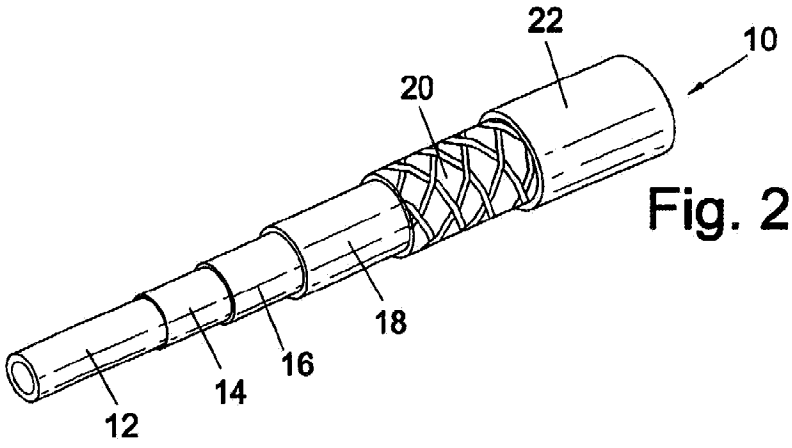

Fig. 2

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At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

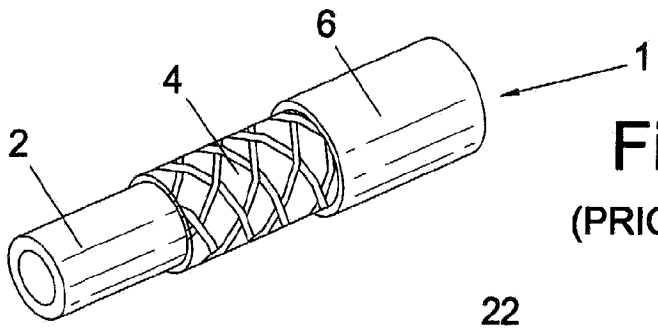

Fig. 1
(PRIOR ART)

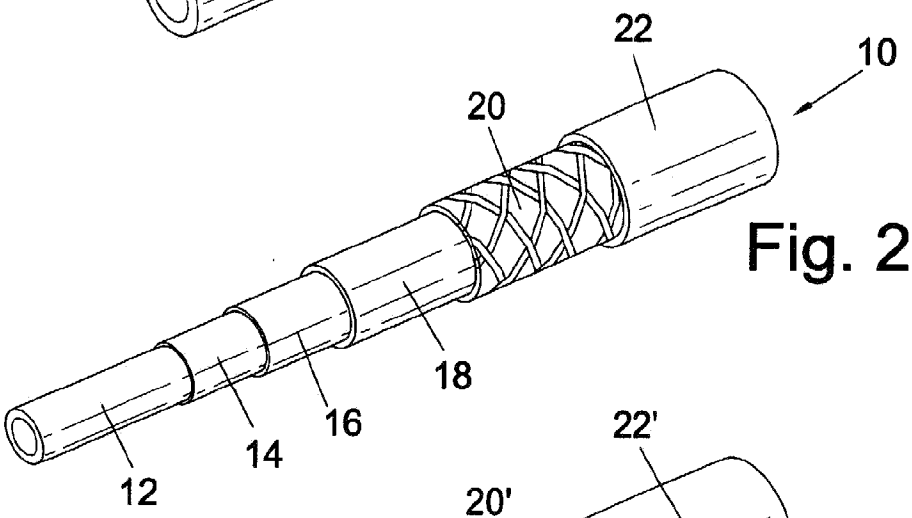

Fig. 2

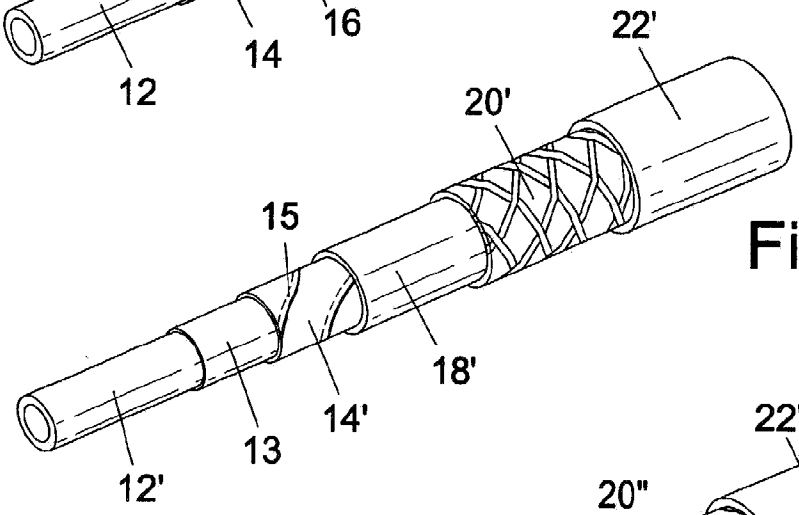

Fig. 3

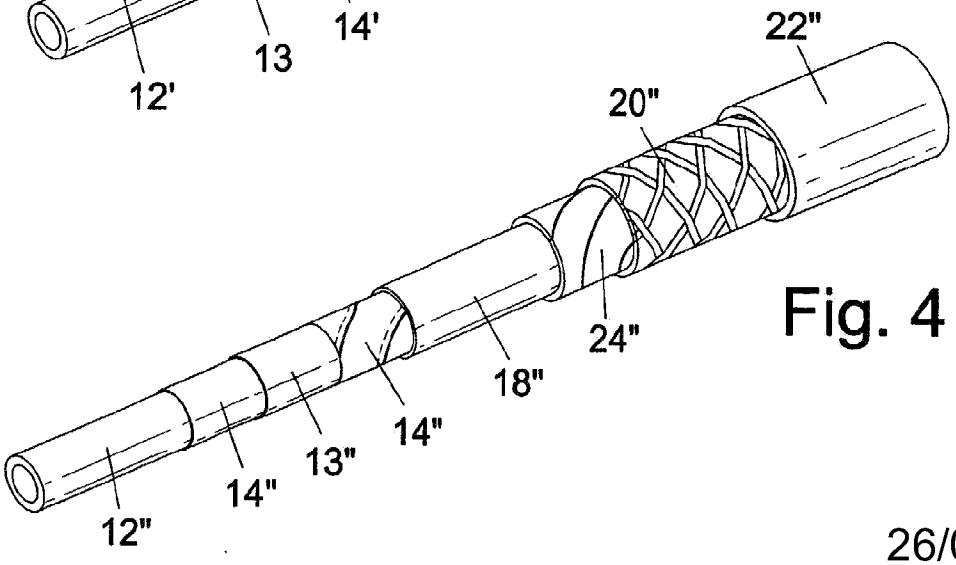

Fig. 4

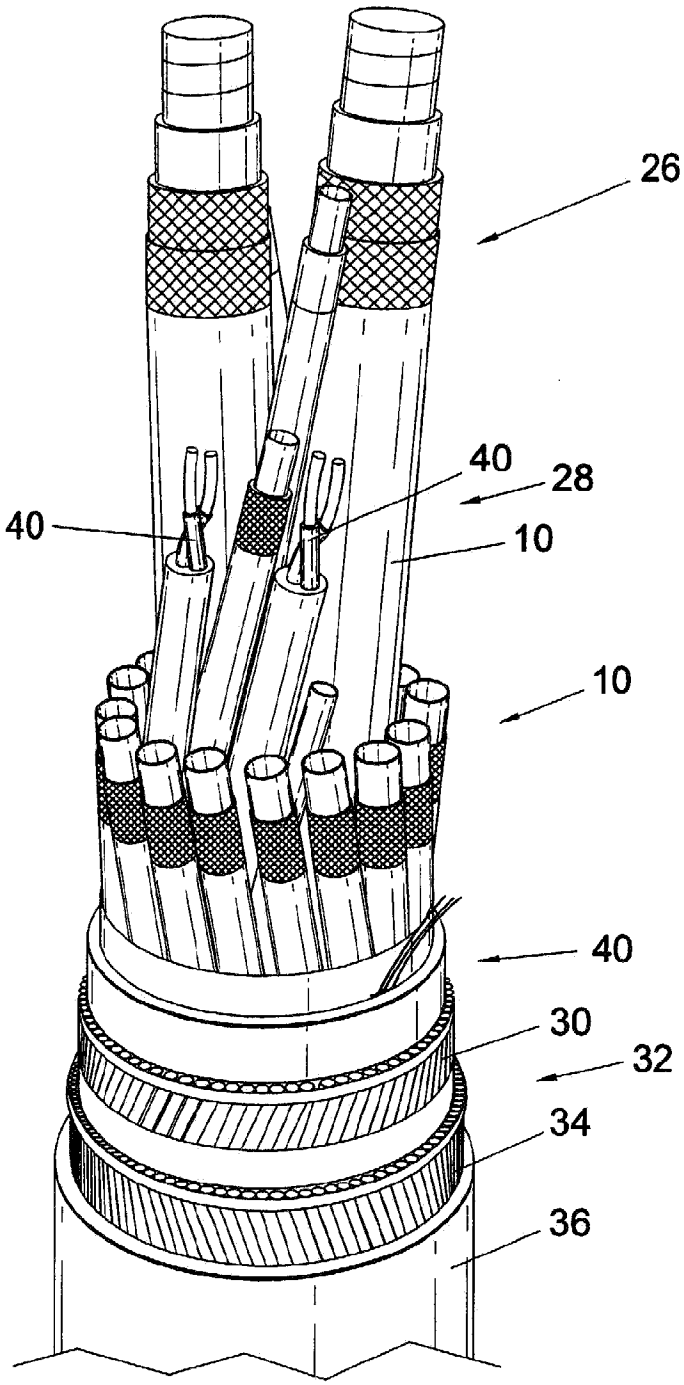

Fig. 5

FLUID CONDUIT

The present invention relates to a conduit for transporting fluids, particularly chemicals with small molecular size, eg, methanol, ethanol and hydrocarbon fluids, and particularly to a multi-conduit umbilical for the transportation of such fluids over very long lengths, typically in excess of 50 km.

In off-shore drilling environments, it is necessary to supply chemicals such as methanol or glycol to the wellhead and this is achieved using flexible hoses or multi-conduit hoses, sometimes referred to as umbilicals. Such umbilicals may be from 50m in length to well in excess of 100km in length in use in the field. In a multi-conduit hose or umbilical, each of the flexible hoses therein may be used for transporting different types of chemical, eg, one for transporting methanol and one for glycol and others for transporting other hydrocarbon gases. Additionally, in an umbilical there may be other lines such as hydraulic control lines, injection lines and/or service lines, eg, electrical conductors and fibre optic cabling. The present invention relates also to so called "High Collapse Resistant Hoses" of the type used in deep sea applications, which, in use, must be able to resist collapsing due to the very large pressures exerted thereon.

United Kingdom Patent Publication No. GB2245678A discloses an umbilical for use in the transportation of the aforesaid chemicals, eg, methanol and glycol. A particular disadvantage that has been identified with hoses generally and in particular the umbilical, and hoses, disclosed in the aforesaid publication is that they are permeable, to a greater or lesser extent, to chemicals with small molecular sizes/molecular shapes, as those found in methanol, ethanol and other hydro-carbon gases. Nylon material has been used for many years in conduits and Nylon 11 in particular has good physical stability except that it has poor permeation characteristics. Over long lengths, typically several kilometres, GB2245678A utilises materials which have slightly improved permeation characteristics but such an arrangement is not wholly acceptable to the offshore industry from an emissions perspective and lack the physical stability of materials such as Nylon 11. Furthermore it will be appreciated that over very long lengths material costs are a significant factor to be considered.

Additionally, it has been found that it is possible for there to be cross contamination between adjacent hoses within an umbilical wherein chemicals transported through one hose permeate out of that hose into an adjacent hose which may contain a different chemical.

Conduits and umbilicals for the transportation of various fluids are described variously in EP 1020673, JP 2000-002375, US 4570680, GB 838070 & GB 699543.

Another issue in conduits/umbilicals of a one piece construction and very long length, typically in excess of 100 km, is that permeation is acceptable, where the conduit/umbilical is, for example, under water, but permeation is to be avoided where the umbilical surfaces, top side, or when the conduit/umbilical passes across ground because of the hazardous/flammable nature of some permeable fluids. Umbilicals having a plurality of different fluid conduits having differing permeation characteristics along a given length have not previously been proposed.

Moreover hoses for umbilicals are generally produced in very long lengths e.g. 100 km or more and are required to have a combination of features to make them suitable for subsea use e.g. high temperature resistance, high chemical resistance and low permeation rates. Some flouropolymers are particularly suitable for this application but production of conduits in the aforesaid extremely long lengths is not possible due to oligomer and low molecular species building up on extrusion tools and damaging the liner/conduit after a short while.

It is an object of the present invention to avoid or minimise one or more of the aforesaid problems.

The present invention provides a fluid conduit for the transportation of chemicals with small molecular size and shape, eg, methanol, ethanol and hydrocarbon fluids and which is suitable for use in a multi-conduit umbilical, which conduit comprises a generally flexible fluid hose encapsulated by at least one metallised layer formed and arranged to substantially minimise permeation therethrough of fluid being transported in said fluid hose and, in use, in a multi-conduit umbilical to substantially minimise permeation into said fluid hose from adjacent hoses containing chemicals characterised in that sections or lengths of said fluid hose have differing levels of encapsulation, and thereby permeation, along a given length thereof according to the operational requirement of the fluid conduit or umbilical.

The present invention also provides a multi-conduit umbilical comprising a plurality of the aforesaid fluid conduits, according to a first aspect of the invention, bundled together and provided with at least one of a hose reinforcement structure surrounding said bundle of fluid conduits and an outer sheath.

Thus, with a fluid conduit and/or multi-conduit umbilical, according to either aspect of the present invention, the problems of permeation of fluid contained therein at critical position(s) along a length of conduit/umbilical is significantly minimized.

Preferably said flexible fluid hose is in the form of a thermoplastic hose, for example a polyethylene, a cross-linked polyethylene or a polyamide such as Nylon 11 (Trade Mark). Preferably said fluid hose has a wall thickness which lies in the range of from 0.5 to 10mm and more preferably in the range 1.5mm to 2.5mm for hose bore diameter of 25.4mm. Examples of fluid hose suitable for use in the applications described herein above will be known to those generally skilled in the art. The invention does allow for the use of lower cost hose liner materials to be used than previously as such hoses generally have higher inherent permeation rates.

Where the fluid to be transported is particularly corrosive or is exposed to high temperatures, then there may be used a chemical and temperature resistant polymer such as a fluoropolymer. The invention permits the use of hose materials that have very high temperature rating and very high generic chemical resistance but typically have poor permeation performance e.g. the aforesaid flouropolymers. Such materials have been discounted in the past because of such poor

permeation performance. In particular it will be noted that permeation rates increase with ascending temperatures and as such fluid hoses and umbilicals are generally placed on the sea bed (where the temperature is relatively constant 4°C), significant advantages can be realised.

Such an arrangement makes the present invention particularly suitable for use in replacing existing designs wherein are used substantially metallic tubes instead of the aforesaid thermoplastic hoses. Whilst substantially metallic tubes provide extremely low levels of permeation, they tend to be expensive, heavy and difficult to handle and manipulate. Additionally metallic tubes are less robust, subject to fatigue, more fragile and have a generally lower reliability record than thermoplastic hoses.

Preferably said metallised layer comprises at least one layer of metal. Said metals may be selected from the group including copper, nickel, chrome, aluminium and alloys thereof. Preferably said metals are suitable for use in long term, sub-sea applications and are compatible with the material of the fluid hose which they are encapsulating and the materials of other features of the umbilical.

Preferably said metallised layer or layers may be applied to the fluid hose by any suitable means including electroplating or spraying of metallised material onto the outer surface of the fluid hose. Preferably said metallised layer has a thickness in the range of 2 microns to 2mm, depending on the particular applications/hose diameter. Preferably said fluid hose is formed by a continuous extrusion process and around which the metallised layer is applied directly, so as to be received by the nascent cross linked polyethylene, polyethylene or polyamide surface or fluoropolymer surface. Where there is used an electroplating or spraying process, there may be applied several layers of said metallised material and indeed there may be used different metals for each different layer so as to give the fluid conduit the required impermeability/fluid handling characteristics required.

Alternatively, said metallised layer may comprise a film or tape applied over the outer surface of the fluid hose. Desirably said metallised layer in a film or other form provides at least 90% coverage around the hose. Preferably said metallised tape or film is made from one of the metals referred to above. Said tape may be provided with a means for bonding said tape to the outer surface of said fluid hose. Means of bonding may include an adhesive or a chemical bond or

simply the physical wrapping of a tape helically around the hose with or without a significant degree of overlap, eg, 400% coverage. The metallic layer may or may not have a backing film such that it can either have a further coating or no coating or be coated with an extruded polymer or hose reinforcement structure to facilitate protection of the metallised layer. Alternatively, there may be provided a taped polymeric layer which may be bonded (chemical, adhesive or otherwise) to the metallised tape layer or film.

Said encapsulation of the fluid hose may be along the full length of said hose or at predetermined positions/lengths along a fluid conduit/umbilical.

Desirably said metallised layer can be used as a means of leak, failure or hose break detection. For example where a fluid hose fails, for example by hydraulic jetting, this may cause the metallised layer to loose its continuity. Layer continuity can be measured using known testing techniques such as time Time Domain Reflectometry or Murray Loop testing. Advantageously this provides a means of quickly and easily detecting a fault along a long length of umbilical.